

In re Patent Application of:

CONTI

Serial No. 10/606,189

Filing Date: June 25, 2003

REMARKS

Applicant would like to thank the Examiner for the thorough examination of the present application.

Applicant also notes that the Examiner did not initial the last prior art reference on the information disclosure sheet filed on June 25, 2003. Accordingly, it is requested that the reference cited therein be confirmed as considered by the Examiner and officially made of record.

The arguments supporting patentability of the claims are provided below.

I. The Claimed Invention

The present invention, as recited in independent Claim 9, for example, is directed to a radio-frequency (RF) switching device comprising an input/output terminal, a plurality of RF channels connected to the input/output terminal, and switching means for selecting one of the plurality of RF channels based upon a switching control signal.

The switching means comprises a respective control module connected to each RF channel. Each control module comprises a control input for receiving the switching control signal, a PIN diode having a cathode connected to the input/output terminal, and an anode. A control transistor comprises a control terminal connected to the control input, and a first conducting terminal connected to the anode of the PIN diode. The first conducting terminal forms a common node between an anode of a PN diode formed by the control terminal and the first conducting terminal of the control transistor and a corresponding parasitic PN diode.

The RF switching device advantageously comprises a

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plurality of RF channels connected to the input/output terminal. Each RF channel may be dedicated to a different transmission standard operating at different frequencies, for example. Each respective control module advantageously has very good radio-frequency isolation when one of the radio-frequency channels is selected in order to reduce the loss of energy in the selected channel. This isolation is based upon the combination of the PIN diode and the control transistor.

Independent Claim 15 is similar to independent Claim 9 but further recites that "the first conducting terminal of the control transistor forms a common node between an anode of a diode formed by the control terminal and the first conducting terminal of the control transistor, and a corresponding parasitic diode." Independent Claim 15 does not recite the switching means or that the diode is a PIN diode.

Independent Claim 23 is directed to a remote terminal for operating in a wireless communication system and is similar to independent Claim 15. Independent Claim 33 is directed to a method for making an RF switching device and is also similar to independent 15.

II. The Claims Are Patentable

The Examiner rejected independent Claim 9 over the published Tamura patent application in view of the published Clifton patent application, in view of the Ashar et al. patent and in view of the Ogawa patent. Similarly, independent Claims 15, 23 and 33 have been rejected over the published Tamura patent application in view of the published Clifton patent application and in view of the Ogawa patent.

In the Tamura patent application, the Examiner

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referenced in FIG. 1 a radio-frequency (RF) switching device **100** comprising an input/output terminal **101**, and a plurality of RF channels **102, 103** connected to the input/output terminal, and switching means for selecting one of the RF channels based upon a switching control signal.

In FIG. 11c in the Tamura patent application, the Examiner characterized the switching means as comprising a respective control module **307** connected to each RF channel **302**. Each control module **307** comprises a control input **CONT** for receiving the switching control signal, a PIN diode **D1** having a cathode connected to the input/output terminal, and an anode. A control transistor **Q1** comprises a control terminal connected to the control input **CONT**, and a first conducting terminal connected to the anode of the PIN diode **D1**.

As correctly noted by the Examiner, the Tamura patent application fails to disclose 1) the amount of RF channel selection in terms of a plurality, and 2) that the first conducting terminal forms a common node between an intersection of an anode of a PN diode formed by the control terminal and the first conducting terminal of the control transistor, and a corresponding parasitic PN diode (as best shown in FIG. 4 in the present invention).

The Examiner cited the published Clifton patent application as disclosing element 1) above, which is directed to a frequency-switching device having a plurality of frequency channels. The Examiner cited the Ashar et al. patent and the Ogawa patent as disclosing element 2) above, which in FIG. 13 (in the Ogawa patent) illustrates a transistor formed by two diodes. The two diodes are used to

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form the common node.

The Examiner has taken the position that since the Tamura patent application is used in radio communication apparatus (paragraph 116), and since the published Clifton patent application is a radio communication apparatus equipped with multi-band capability with an antenna switch, it would have been obvious to modify the switching apparatus of the Tamura patent application with more input/output terminals to make the apparatus a multi-mode apparatus.

The radio communication apparatus in the Tamura patent application is provided with a high frequency switch that can switch a high frequency signal at a high speed. In particular, the communication apparatus comprises a first switch **106** and a second switch **108** that connect control lines to a bias power supply **111**. The high frequency switch has switches loaded in parallel at the respective portions a predetermined wavelength away, respectively, from a branch point of a common terminal **112** toward the respective terminals **102, 103**. Control lines are connected in parallel to the respective signal lines to supply a bias, respectively, for controlling ON/OFF operation of the switches. A third switch **107** and a fourth switch **109** connect the control lines to the respective ground potentials.

The Applicant submits that the high frequency switch in the Tamura patent application would require further modification for connecting more input/output terminals to the common terminal **112**, and such a modification is beyond the scope of the patent application. For instance, the Tamura patent application requires that the switches be loaded in parallel at the respective portions a predetermined wavelength

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(1/4 wavelength) from the common terminal 112 to match input/output impedance to prevent generation of reflected waves. Moreover, control of these switches is based upon the control section 110 and their interface with the bias power supply 111. Adding additional channels increases the complexity of the high frequency switch since additional signals would be required by the control section 110, and the additional channels would also have to interface with the bias power supply 111.

The Tamura patent application simply fails to teach or suggest that the high frequency switch can be modified so that the communication device can switch to one of a plurality of channels. In fact, the Tamura patent application teaches the opposite, i.e., only one channel can be selected when a channel has already been selected. Adding additional channels to the switching device in the Tamura patent application thus increases its complexity that would result in additional work beyond that already disclosed by the Tamura patent application.

The Clifton patent application illustrates in FIG. 2 a triple band antenna switch arrangement. A plurality of transmit connections **TX1**, **TX2** and receive connections **RX1**, **RX2**, **RX3** are connected to an antenna connection **30** via respective signal paths. A single transistor **32** is in each channel path. However, Clifton notes that four series transistors, such as JFETs, may actually be provided in series for each channel path, with the source of one transistor connected to the drain of the adjacent transistor. A resistor **40** bridges the drain and source of each transistor and a bias voltage is provided to the drains and sources of the

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transistors from a supply voltage Vdd via a diode **42**, a radio frequency isolation capacitor **44** and respective resistors **46**.

Even though the Clifton patent application supports selection from among a plurality of channels connected to the antenna, the respective control modules in the claimed invention are distinctly different when compared to how the channels are selected in Clifton.

In addition, the Clifton patent application does not make any reference to high frequency switching. Consequently, one skilled in the art would not be motivated after examining the Tamura patent application to look to the Clifton patent application, particularly since the two applications are directed to different problems. The Tamura patent application is directed to a high frequency switch supporting one of two channels, whereas the Clifton patent application discloses a triple band antenna arrangement.

In addition, there is no motivation to modify the respective control modules in the Tamura patent application so that the first conducting terminal of the control transistor **Q1** (as shown in FIG. 11C) also forms a common node between an intersection of an anode of a PN diode formed by the control terminal and the conducting terminal of the control transistor, and a corresponding parasitic PN diode.

The Tamura patent application fails to mention parasitic diodes. The control module **306** (FIG. 11C) in the Tamura patent application works in cooperation with switches **307** and **309** so that the high frequency switch is capable of performing a high speed changeover by setting up the switches **307** and **309** as the paths for discharging the electric charge accumulated in the PIN diodes **D1** and **D2** at high speed.

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Even though the Ashar et al. patent and the Ogawa patent disclose a transistor formed by two diodes, the Ashar et al. patent fails to mention connecting the transistor as a PN diode with a corresponding parasitic PN diode being associated therewith. The same may be said about the Ogawa combination of the PIN diode and the control transistor having its conducting terminal connected to the anode of the PIN diode and forming the common node between the PN diodes. The Ogawa patent discloses parasitic capacitances but fails to disclose connecting the transistor as a PN diode with a corresponding parasitic PN diode being associated therewith.

In the claimed invention, the RF switching device comprises a plurality of RF channels connected to the input/output terminal. Each respective control module advantageously has very good radio-frequency isolation when one of the radio-frequency channels is selected in order to reduce the loss of energy in the selected channel. As recited in independent Claim 9, this isolation is based upon the combination of the PIN diode and the control transistor having its first conducting terminal connected to the anode of the PIN diode and forming the common node between an anode of a PN diode formed by the control terminal and the first conducting terminal of the control transistor, and a corresponding parasitic PN diode.

The Applicant thus submits that there is no motivation to selectively combine the references as suggested by the Examiner. If appears that the Examiner is impermissibly using hindsight reconstruction by using the Applicant's specification as a roadmap for combining disjointed prior art references together. Accordingly, it is

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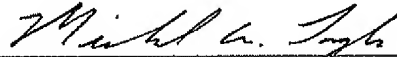
submitted that independent Claim 9 is patentable over the Tamura patent application in view of the Clifton patent application, the Ashar et al. patent and the Ogawa patent.

Independent Claims 15, 23 and 33 are similar to independent Claim 9. Therefore, it is submitted that these claims are also patentable over the Tamura patent application in view of the Clifton patent application. In view of the patentability of the independent Claims 9, 15, 23 and 33, it is submitted that the dependent claims, which include yet further distinguishing features of the invention are also patentable. These dependent claims need no further discussion herein.

III. CONCLUSION

In view of the arguments provided herein, it is submitted that all the claims are patentable. Accordingly, a Notice of Allowance is requested in due course. Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Respectfully submitted,



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